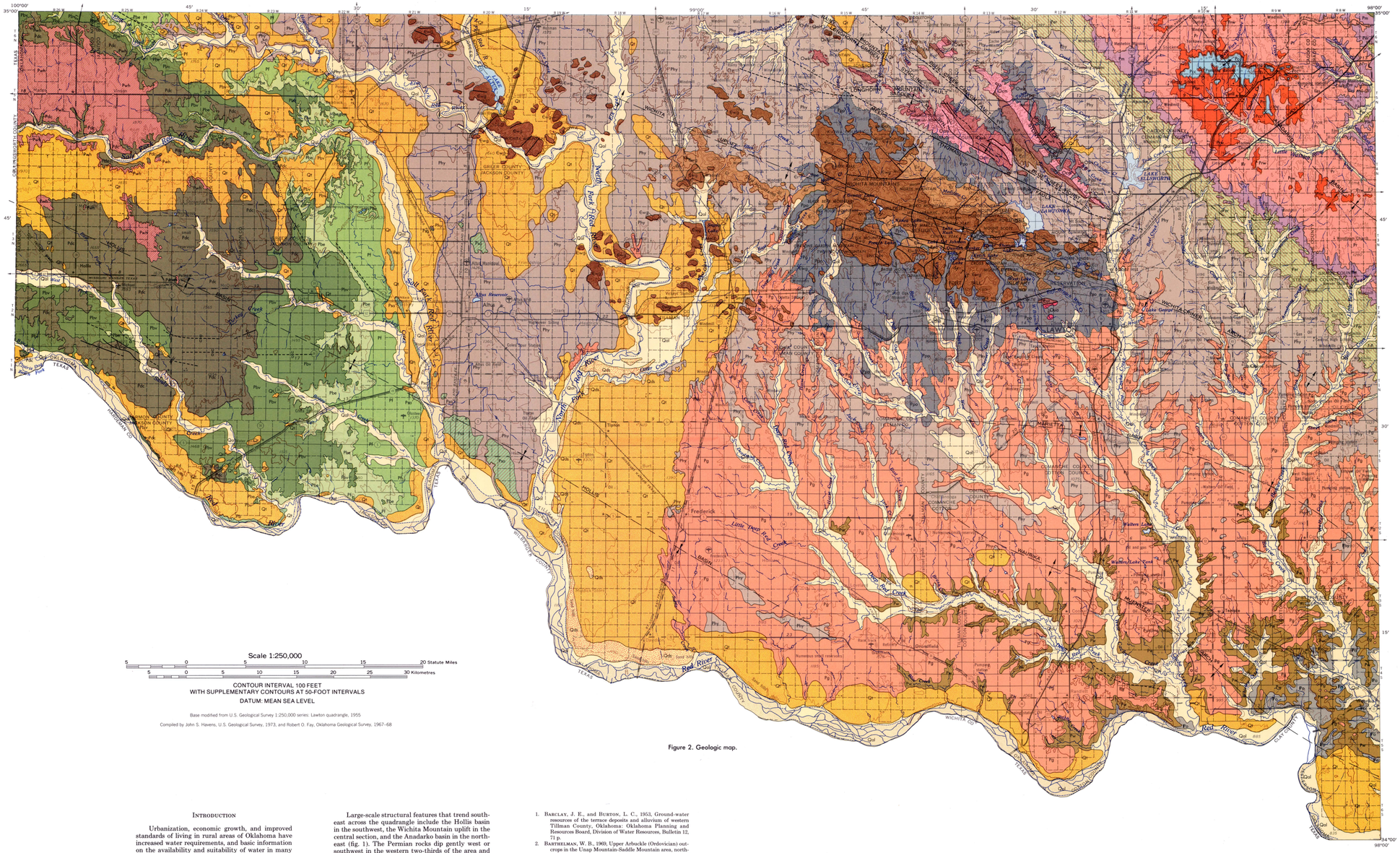

Figure 2. Geologic map.

EXPLANATION

The stratigraphic nomenclature and age determinations used herein are those accepted by the Oklahoma Geological Survey and do not necessarily agree with those of the U.S. Geological Survey.

QUATERNARY

Qal — ALLUVIUM

Sand, clay, and gravel, as much as 50 feet (15 m) thick; shown only along major streams and tributaries.

Qds — DUNE SAND

Wind-laid sand; maximum thickness about 50 feet (15 m).

Qt — TERRACE DEPOSITS

Sand, clay, and gravel; thickness as much as 75 feet (23 m) in Tillman County, ranging from 5 to 50 feet (2 to 15 m) elsewhere.

UNCONFORMITY

PERMIAN

Pcc — CLOUD CHIEF FORMATION

Represented in this area by the *Moccasin Creek Gypsum Member*, which is about 30 feet (9 m) thick.

Pwh, Prw, Pr, Pm — WHITEHORSE GROUP

Predominantly orange-brown, fine-grained sandstone, the *Whitehorse Group* is mapped as Pwh where separate formations have not been distinguished and as the *Rush Springs Formation* and the *Marlow Formation* where identified.

Whitehorse Group undifferentiated, Pwh, fine-grained sandstone and siltstone as much as 100 feet (30 m) thick in western part of quadrangle, interbedded with gypsum beds 3 to 10 feet (1 to 3 m) thick.

Rush Springs Formation, Pr, very fine-grained, cross-bedded sandstone, 130 to 300 feet (41 to 90 m) thick. The *Weatherford Gypsum Bed*, Prw, contains gypsum and dolomite and is as much as 60 feet (18 m) thick in the upper part of the Rush Springs.

Marlow Formation, Pm, very fine-grained sandstone with some silty shale; thickness, about 90 to 130 feet (27 to 40 m); contains 2 thin gypsum and (or) dolomite beds in upper 20 feet (6 m)—the *Emanuel Bed* (at top) and the *Relay Creek Bed* (20 feet below top).

Pdc, Pby, Pb, Pbe, Per, Pf, Pye — EL RENO GROUP

Primarily evaporites and reddish-brown shale, with deltaic clastics to the east. In the eastern part of the quadrangle, separate formations have not been distinguished, and the *El Reno Group* is mapped as Per; in the western part of the quadrangle, the group has been mapped as four separate formations.

El Reno Group undifferentiated, Per, in northeastern part of quadrangle, includes *Chickasha Formation*—sandstone, shale, and siltstone, 400 to 580 feet (120 to 180 m) thick—and underlying *Duncan Sandstone* (equivalent to San Angelo Sandstone)—sandstone with some shale, 100 to 250 feet (30 to 76 m) thick.

Dog Creek Shale, Pdc, reddish-brown silty shale, 85 to 190 feet (26 to 58 m) thick.

Blaine Formation, Pb, interbedded gypsum, dolomite, and shale, 190 to 215 feet (58 to 66 m) thick. *Van Vacter Member*, Pbv, of the Blaine Formation contains 6 dolomite-gypsum-shale sequences with a total thickness of 80 to 105 feet (24 to 32 m); *Elm Fork Member*, Pbe, contains 3 dolomite-gypsum sequences with a total thickness of 80 to 110 feet (24 to 34 m).

Flowerpot Shale, Pf, reddish-brown and greenish-gray shale, interbedded with greenish-gray siltstone; thickness, about 175 to 195 feet (53 to 59 m).

San Angelo Sandstone, Psa, interstratified sandstone, mudstone conglomerate, and shale, as much as 80 feet (24 m) thick.

Phy, Pgo, Pg — POST OAK CONGLOMERATE, HENNESSEY GROUP AND GARBER SANDSTONE

Post Oak Conglomerate, Pgo, limestone conglomerate near limestone outcrops; contains zeolite-opal (*Tyner Creek Formation*) locally, near gabbro and anorthosite outcrops; arkosic gravel and cobbles near igneous outcrops. These rock types are interbedded with sand, silt, clay, and shale, as much as 500 feet (150 m) thick at surface but several thousand feet thick in subsurface, extending down section into Pennsylvanian rocks.

Hennessey Group, Phy, reddish-brown to gray shale with some tan sandstones, 130 to 200 feet (40 to 60 m) thick (locally unconformable on Cambrian igneous rocks).

Garber Sandstone, Pg, reddish-brown, fine-grained sandstone and mudstone conglomerate, 160 to 210 feet (49 to 64 m) thick, containing a basal sandstone, the *Asphaltum Sandstone Bed*, about 10 to 60 feet (3 to 18 m) thick.

Pw — WELLINGTON FORMATION

Maroon shale, about 130 feet (40 m) thick, with greenish-gray and black sandstone of the *Ryan Sandstone Bed* at base.

Summer Group

PENNSYLVANIAN

Po — OSCAR GROUP

Shale, sandstone, and arkose, 300 to 500 feet (90 to 150 m) thick, base covered.

UNCONFORMITY

ORDOVICIAN

Ovb — VIOLA LIMESTONE AND BROMIDE FORMATION

Limestone, interbedded limestone and shale, and sandstone; thickness, about 900 feet (270 m), faulted in isolated areas, top eroded, base covered.

Ocu, Owk, Ocm — UPPER PART OF ARBUCKLE GROUP

Predominantly limestone and dolomite, 4,000 feet (1,200 m) thick, faulted in isolated areas.

Upper part of Arbuckle Group undifferentiated, Oua, faulted in isolated areas north of Lawton.

West Spring Creek Formation and *Kindblade Formation*, Owk, dolomite, dolomitic sandstone, conglomerate, and limestone; thickness, approximately 2,000 feet (600 m).

Cool Creek Formation and *McKenzie Hill Formation*, Ocm, limestone and conglomerate with abundant quartz sand and cherty zones; thickness, approximately 2,000 feet (600 m).

Eot — LOWER PART OF ARBUCKLE GROUP AND TIMBERED HILLS GROUP

Limestone, dolomite, siltstone, sandstone, conglomerate, and shale, with glauconitic and hematitic zones; thickness, 1,200 to 2,000 feet (370 to 600 m), faulted in isolated areas. Lower part of *Arbuckle Group* includes *Signal Mountain Formation*, *Royer Dolomite*, and *Fort Sill Limestone*; *Timbered Hills Group* includes *Honey Creek Formation* and *Reagan Sandstone*.

UNCONFORMITY

CAMBRIAN

Ecr — CARLTON RHYOLITE GROUP

Rhyolite flows, tuffs, conglomerate beds, and diabase sills; thickness, 4,500 feet (1,370 m).

Ewg — WICHITA GRANITE GROUP

Granites of various textures; thickness, 600 to 15,000 feet (180 to 4,570 m).

Er — RAGGEDY MOUNTAIN GABBRO GROUP

Gabbro, anorthosite, and diorite; thickness, as much as 10,000 feet (3,000 m).

Contact

Gradational contact

Fault, approximately located; dotted where concealed; U, upthrown side; D, downthrown side

Monoclinal flexure, dashed where inferred, hachures indicate direction of steeper bend

Anticline

Syncline

INTRODUCTION

Urbanization, economic growth, and improved standards of living in rural areas of Oklahoma have increased water requirements, and basic information on the availability and suitability of water in many parts of the State is needed by planners and individual water users for development of this vital resource. To provide this information on a regional basis, the U.S. Geological Survey, in cooperation with the Oklahoma Geological Survey, is making reconnaissance appraisals of the water resources, with special emphasis on ground water, throughout the State. The Lawton quadrangle, which includes about 5,460 square miles (4,100 km²) in southwestern Oklahoma (fig. 1), is one of the 9 quadrangles included in the appraisal studies. The report provides information on the areal distribution, availability, and chemical quality of ground water, plus summaries of available data on the chemical quality and availability of surface water.

Information used to appraise the water resources of the Lawton quadrangle was obtained during field investigations, taken from U.S. Geological Survey reports and files, and obtained from published and unpublished records of State and Federal agencies. Data obtained during a study of water availability from carbonate rocks of the Ordovician and Cambrian Arbuckle Group in the vicinity of the Wichita Mountains have been included in this report. Special acknowledgment for providing useful information is due the U.S. Public Health Service, Oklahoma Water Resources Board, Oklahoma State Department of Health, and officials of cities and of rural water cooperatives. The cooperation and assistance of many individuals who provided useful information are also acknowledged.

GEOLOGIC SETTING

The geology of the Lawton quadrangle is shown in detail in figure 2. Granite, rhyolite, and gabbro of Cambrian age form the Wichita Mountains north of Lawton and form scattered outcrops to the west. Shale and carbonate rocks of Cambrian and Ordovician age are most extensively exposed in the Limestone Hills on the north side of the Wichita Mountains. Red beds, sandstone, and gypsum of Permian age crop out over much of the quadrangle. Quaternary terrace deposits and wind-laid sand occupy extensive areas in Tillman County. Alluvium is present along most stream channels.

Large-scale structural features that trend southeast across the quadrangle include the Hollis basin in the southwest, the Wichita Mountain uplift in the central section, and the Anadarko basin in the northeast (fig. 1). The Permian rocks dip gently west or southwest in the western two-thirds of the area and northeast in the remaining part. The Limestone Hills are downthrown north of the Meers fault (fig. 2), which may have a displacement of as much as 4 miles (6 km).

CONVERSION FACTORS

English units used in this report may be converted to metric units with the following conversion factors:

English Unit	*Multiply by*	*Metric unit obtained*
inches	25.4	millimetres (mm)
feet (ft)	.3048	metres (m)
miles	1.609	kilometres (km)
square miles (mi²)	2.590	square kilometres (km²)
acres	.4047	hectares (ha)
gallons per minute (gal/min)	.06309	litres per second (l/s)
cubic feet per second (ft³/s)	.02832	cubic metres per second (m³/s)
	28.32	litres per second (l/s)
acre-feet	1,233	cubic metres (m³)
	.00123	cubic hectometre (hm³)

REFERENCE CITED

JOHNSON, K. S., 1972, Introduction to the geology of Oklahoma, *in* Johnson, K. S., Branson, C. C., Curtis, N. M., Jr., Ham, W. E., Marcher, M. V., and Roberts, J. F., Geology and earth resources of Oklahoma—an atlas of maps and cross sections: Oklahoma Geological Survey Educational Publication 1, 8 p.

SOURCES OF GEOLOGIC INFORMATION

The sources of information used to compile the geologic map of the Lawton quadrangle are listed below; the area reported upon by each source is shown in figure 3. Soil Surveys conducted by the U.S. Department of Agriculture, Soil Conservation Service, were used to define limits for the alluvium in Comanche, Cotton, Greer, Jackson, Jefferson, Stephens, and Tillman Counties.

1. BARCLAY, J. E., and BURTON, L. C., 1953, Ground-water resources of the terrace deposits and alluvium of western Tillman County, Oklahoma: Oklahoma Planning and Resources Board, Division of Water Resources, Bulletin 12, 71 p.
2. BARTHELMAN, W. B., 1969, Upper Arbuckle (Ordovician) outcrops in the Unap Mountain-Saddle Mountain area, northeastern Wichita Mountains, Oklahoma: University of Oklahoma unpublished M.S. thesis, 67 p.
3. BROOKAY, H. E., 1968, Upper Arbuckle (Ordovician) outcrops in the Richards Spur-Kindblade Ranch area, northeastern Wichita Mountains, Oklahoma: University of Oklahoma unpublished M.S. thesis, 73 p.
4. CHASE, G. W., 1954, Permian conglomerate around Wichita Mountains, Oklahoma: American Association of Petroleum Geologists, v. 31, no. 9, p. 2028–2035.
5. DAVIS, L. V., 1955, Geology and ground-water resources of Grady and northern Stephens Counties, Oklahoma: Oklahoma Geological Survey Bulletin 73, 184 p.
6. FAY, R. O., 1968, Geology of region II, *in* Appraisal of the water and related land resources of Oklahoma: Oklahoma Water Resources Board Publication 19, 131 p.
7. FAY, R. O., 1971, Field maps: Oklahoma Geological Survey unpublished field maps.
8. FOX, C. S., 1958, The Honey Creek Formation of the Wichita Mountains, Oklahoma: University of Oklahoma unpublished M.S. thesis, 61 p.
9. HAM, W. E., DENISON, R. E., and MERRITT, C. A., 1964, Basement rocks and structural evolution of southern Oklahoma: Oklahoma Geological Survey Bulletin 95, 302 p., 16 pls.
10. HARLTON, B. H., 1951, Faults in sedimentary part of Wichita Mountains of Oklahoma: American Association of Petroleum Geologists Bulletin, v. 35, p. 988–999.
11. HOLLOWELL, J. R., 1965, Ground water in the alluvium of Otter Creek basin, Oklahoma: Oklahoma Water Resources Bulletin 27, 15 p.
12. JOHNSON, K. S., and HAM, W. E. (in preparation), Geology and mineral resources of the Permian Blaine Formation and associated strata in southwestern Oklahoma: Oklahoma Geological Survey Bulletin.
13. MERRITT, C. A., 1958, Igneous geology of the Lake Altus area, Oklahoma: Oklahoma Geological Survey Bulletin 76, 70 p.
14. MISER, H. D., and others, 1954, Geologic map of Oklahoma: U.S. Geological Survey and Oklahoma Geological Survey, scale 1:500,000.
15. NELMS, J. L., 1958, The Fort Sill Formation of the Wichita Mountains, Oklahoma: University of Oklahoma unpublished M.S. thesis, 91 p.
16. OAKES, M. C., 1967, Geology of Comanche County, *in* Mobley, H. L., and Brinlee, R. C., 1967, Soil survey, Comanche County, Oklahoma: U.S. Department of Agriculture, Soil Conservation Service, 58 p., 95 pls.
17. SCHOONOVER, P. E., 1948, The igneous rocks of the Fort Sill Reservation, Oklahoma: University of Oklahoma unpublished M.S. thesis, 123 p.
18. TANAKA, H. H., and DAVIS, L. V., 1963, Ground-water resources of the Rush Springs Sandstone in the Caddo County area, Oklahoma: Oklahoma Geological Survey Circular 61, 63 p., 11 figs., 2 pls.
19. WILMOTT, C. L., JR., 1957, The Reagan Formation of the Wichita Mountains, Oklahoma: University of Oklahoma unpublished M.S. thesis, 60 p.

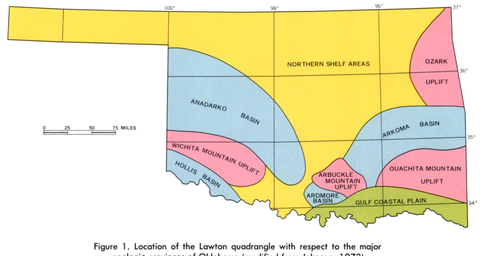

Figure 1. Location of the Lawton quadrangle with respect to the major geologic provinces of Oklahoma (modified from Johnson, 1972).

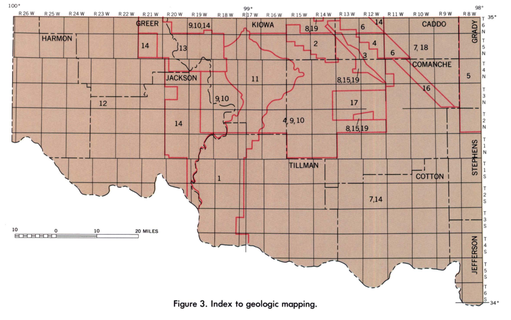

Figure 3. Index to geologic mapping.

RECONNAISSANCE OF THE WATER RESOURCES OF THE LAWTON QUADRANGLE, SOUTHWESTERN OKLAHOMA

By

John S. Havens
U.S. Geological Survey

1977

Cartographic preparation by Oklahoma Geological Survey